

WHAT IS CLAIMED IS:

1. A transmission unit which transmits and receives digital signals over a first and second network systems, comprising:

(a) first signal interface means for transmitting and receiving first network signals;

(b) second signal interface means for transmitting and receiving second network signals; and

10 (c) two-way signal conversion means for making conversions between the first network signals and the second network signals, comprising:

15 downward conversion means for producing lower-level signals by converting the received first and second network signals down to a lower hierarchical level at which the first and second network systems are compatible with each other in terms of logical signal structure,

20 upward conversion means for converting a given lower-level signal up to a higher hierarchical level which complies with the first or second network system, thereby producing a first or second outgoing higher-level network signal, and

25 looping back means for looping back the produced lower-level signals at the lower hierarchical level to said upward conversion means, thereby causing the received first and second network signals to be converted into the second and first outgoing network signals, respectively.

2. The transmission unit according to claim 1,
wherein:

5 said downward conversion means terminates overhead
information contained in the received first and second
network signals during the downward conversion; and

said upward conversion means inserts overhead
information to the first and second outgoing higher-level
network signals during the upward conversion.

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3. The transmission unit according to claim 1,
wherein:

15 said downward conversion means locates stuff data
contained in the received first and second network signals,
and removes the stuff data during the downward conversion;
and

20 said upward conversion means inserts stuff data to
the first and second outgoing higher-level network signals,
considering which part of such signals should be stuffed
so as to comply with the first and second network systems.

4. The transmission unit according to claim 1,
wherein said two-way signal conversion means makes
transmission rate conversions between the first and second
25 network signals.

5. The transmission unit according to claim 4,

wherein said two-way signal conversion means performs at least one of:

- 5 a conversion from TU-11 to TU-12;
- a conversion from TU-11 to VT-2;
- a conversion from VT-1.5 to TU-12; and
- a conversion from VT-1.5 to VT-2.

6. The transmission unit according to claim 1,
wherein:

- 10 said downward conversion means extracts ATM cells from the received first or second network signal during the downward conversion; and
- 15 said upward conversion means produces the first or second outgoing higher-level network signal by inserting the ATM cells during the upward conversion.

7. The transmission unit according to claim 1,
wherein:

- 20 the received first and second network signals contain IP packets;
- 25 said downward conversion means produces the lower-level signals by converting the received first and second network signals into signals having a common format; and
- 25 said upward conversion means produces the first and second outgoing higher-level network signals by converting upward the common format signals.

8. The transmission unit according to claim 1, wherein said two-way signal conversion means makes the conversions between the first and second network signals which include at least one of:

5 two-way conversions between high-order group signals belonging to different hierarchical series of signals;

10 two-way conversions between low-order group signals belonging to different hierarchical series of signals; and

15 two-way conversions between a high-order group signal and a low-order group signal which belong to different hierarchical series of signals.

15 9. The transmission unit according to claim 1, wherein said two-way signal conversion means makes the conversions between the first and second network signals which include at least one of:

20 two-way conversions between SDH signals and SONET signals;

25 two-way conversions between such signals that belong to the same hierarchical series of signals, but have different levels in the hierarchy;

two-way conversions between PDH signals; and

25 two-way conversions between ATM signals.

10. The transmission unit according to claim 1,

wherein said two-way signal conversion means makes the conversions between the first and second network signals, based on AU pointer types identified.

5 11. The transmission unit according to claim 1, wherein said two-way signal conversion means makes the conversions between the first and second network signals, based on a value given in a byte in a frame overhead.

10 12. The transmission unit according to claim 1, further comprising means for interfacing with a network management console which is used in operations and maintenance of the conversions between the first and second network signals.

15 13. The transmission unit according to claim 1, comprising a low-order group interface which processes low-order group signals,

20 wherein said two-way signal conversion means is employed as an integral part of said low-order group interface.

25 14. A transport system which transmits and receives digital signals over a first and second network systems, comprising:

 (a) a first transmission unit comprising:
 first signal interface means for transmitting and

receiving first network signals over the first network system,

first downward conversion means for producing a first lower-level signal by converting the received first 5 network signals down to a lower hierarchical level at which the first and second network systems are compatible with each other in terms of logical signal structure, and

first upward conversion means for converting a given second lower-level signal up to a higher 10 hierarchical level which complies with the first network system, thereby producing a first outgoing higher-level network signal; and

(b) a second transmission unit comprising:
second signal interface means for transmitting and 15 receiving second network signals over the second network system,

second downward conversion means for producing the second lower-level signal by converting the received second network signal down to the lower hierarchical level 20 at which the first and second network systems are compatible with each other in terms of logical signal structure, and

second upward conversion means for converting the first lower-level signal up to a higher hierarchical level 25 which complies with the second network system, thereby producing a second outgoing higher-level network signal.

15. A transmission unit which transmits and receives digital signals over a first and second network systems, comprising:

(a) first signal interface means for receiving 5 a first network signal and converts the received first network signal into a first internal signal with a fixed bit rate, and for sending an outgoing first network signal which is converted from a given second remapped internal signal with the same fixed rate;

10 (b) second signal interface means for receiving a second network signal and converting the received second network signal into a second internal signal with the fixed bit rate, and for sending out an outgoing second network signal which is converted from a 15 given first remapped internal signal with the same fixed rate;

(c) two-way signal conversion means for making conversions between the first and second network signals; comprising:

20 downward conversion means for producing lower-level signals by converting the first and second internal signals down to a lower hierarchical level at which the first and second network systems are compatible with each other in terms of logical signal structure,

25 upward conversion means for producing a first or second remapped internal signal by converting a given lower-level signal up to a higher hierarchical level which

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complies with the first or second network system, and

looping back means for looping back, at the lower hierarchical level, the lower-level signals from said downward conversion means to said upward conversion means 5 to cause the lower-level signals deriving from the received first and second network signals to be converted to the first and second remapped internal signals, respectively; and

(d) switching means for providing and 10 controlling circuit paths to route the first internal signal, the second internal signal, the first remapped internal signal, and the second remapped internal signal.

16. The transmission unit according to claim 15, wherein:

said downward conversion means terminates overhead information contained in the first and second internal signals during the downward conversion; and

20 said upward conversion means inserts overhead information to the first and second remapped internal signals during the upward conversion.

17. The transmission unit according to claim 15, wherein:

25 said downward conversion means locates stuff data contained in the first and second internal signals, and removes the stuff data during the downward conversion; and

5 said upward conversion means inserts stuff data to the first and second remapped internal signals, considering which part of such signals should be stuffed so as to comply with the first and second network systems, 5 respectively.

10 18. The transmission unit according to claim 15, wherein said two-way signal conversion means makes transmission rate conversions between the first and second network signals.

15 19. The transmission unit according to claim 18, wherein said two-way signal conversion means performs at least one of:

20 15 a conversion from TU-11 to TU-12;
 a conversion from TU-11 to VT-2;
 a conversion from VT-1.5 to TU-12; and
 a conversion from VT-1.5 to VT-2.

25 20. The transmission unit according to claim 15, wherein:

 said downward conversion means extracts ATM cells from the first or second internal signal during the downward conversion; and

25 25 said upward conversion means produces the first or second remapped internal signal by inserting the ATM cells during the upward conversion.

21. The transmission unit according to claim
15, wherein:

the received first and second network signals
5 contain IP packets;

said downward conversion means produces the lower-level signals by converting the first and second internal signals into signals having a common format; and

10 said upward conversion means produces the first and second remapped internal signals by converting upward the common format signals.

22. The transmission unit according to claim
15, wherein said two-way signal conversion means makes the
15 conversions between the first and second network signals which include at least one of:

two-way conversions between high-order group signals belonging to different hierarchical series of signals;

20 two-way conversions between low-order group signals belonging to different hierarchical series of signals; and

25 two-way conversions between a high-order group signal and a low-order group signal which belong to different hierarchical series of signals.

23. The transmission unit according to claim

15, wherein said two-way signal conversion means makes the conversions between the first and second network signals which include at least one of:

two-way conversions between SDH signals and SONET
5 signals;

two-way conversions between such signals that belong to the same hierarchical series of signals, but have different levels in the hierarchy;

two-way conversions between PDH signals; and
10 two-way conversions between ATM signals.

24. The transmission unit according to claim 15, wherein said two-way signal conversion means makes the conversions between the first and second network signals, 15 based on AU pointer types identified.

25. The transmission unit according to claim 15, wherein said two-way signal conversion means makes the conversions between the first and second network signals, 20 based on a value given in a byte in a frame overhead.

26. The transmission unit according to claim 15, wherein further comprising means for interfacing with a network management console which is used in operations 25 and maintenance of the conversions between the first and second network signals.

27. The transmission unit according to claim 15, comprising a low-order group interface which processes low-order group signals,

5 wherein said two-way signal conversion means is employed as an integral part of said low-order group interface.

28. A transport system which transmits and receives digital signals over a first and second network 10 systems, comprising:

(a) a first transmission unit comprising:
first signal interface means for receiving a first network signal and converts the received first network signal into a first internal signal with a fixed bit rate, 15 and for sending out an outgoing first network signal which is converted from a given second remapped internal signal with the same fixed rate;

first downward conversion means for producing a first lower-level signal by converting the first internal 20 signal down to a lower hierarchical level at which the first and second network systems are compatible with each other in terms of logical signal structure, and

first upward conversion means for producing a first remapped internal signal by converting a given 25 second lower-level signal up to a higher hierarchical level which complies with the first network system, and

(b) a second transmission unit comprising:

second signal interface means for receiving a second network signal and converting the received second network signal into a second internal signal with a fixed bit rate, and for sending out an outgoing second network signal which is converted from the first remapped internal signal;

second downward conversion means for producing the second lower-level signal by converting the second internal signal down to a lower hierarchical level at 10 which the first and second network systems are compatible with each other in terms of logical signal structure, and

second upward conversion means for producing the second remapped internal signal by converting the first lower-level signal up to a higher hierarchical level which 15 complies with the second network system.

29. A two-way signal conversion method which converts network signals between a first and second network systems, comprising the steps of:

20 (a) producing lower-level signals by converting a first and second incoming network signals down to a lower hierarchical level at which the first and second network systems are compatible with each other in terms of logical signal structure;

25 (b) producing higher-level signals by converting each given lower-level signal up to a higher hierarchical level which complies with the first or second

network system; and

(c) looping back the produced lower-level signals to said step (b), whereby the lower-level signal resulting from the first incoming network signal will be 5 converted into an outgoing signal to the second network system, and the lower-level signal resulting from the second incoming network signal will be converted into an outgoing signal to the first network system.

10 30. The two-way signal conversion method according to claim 29, wherein:

15 said step (a) of producing the lower-level signals comprises terminating overhead information contained in the first and second incoming network signals during the downward conversion; and

20 said step (b) of producing the higher-level signals comprises inserting overhead information to the outgoing signals during the upward conversion.

31. The two-way signal conversion method according to claim 29, wherein:

25 said step (a) of producing the lower-level signals comprises locating stuff data contained in the first and second incoming network signals, and removing the stuff data during the downward conversion; and

30 said step (b) of producing the higher-level signals comprises inserting stuff data to the outgoing

signals, considering which part of such signals should be stuffed so as to comply with the first and second network systems.

5 32. The two-way signal conversion method according to claim 29, wherein said step (b) of producing the higher-level signals comprises converting transmission rates of the first and second incoming network signals.

10 33. The two-way signal conversion method according to claim 32, wherein the conversions of transmission rates include at least one of:
 a conversion from TU-11 to TU-12;
 a conversion from TU-11 to VT-2;
15 a conversion from VT-1.5 to TU-12; and
 a conversion from VT-1.5 to VT-2.

34. The two-way signal conversion method according to claim 29, wherein:
20 said step (a) of producing the lower-level signals comprises extracting ATM cells from the received first or second network signal during the downward conversion; and
 said step (b) of producing the higher-level signals comprises inserting the ATM cells to the outgoing signals during the upward conversion.
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35. The two-way signal conversion method

according to claim 29, wherein:

the first and second incoming network signals contain IP packets;

5 said step (a) of producing the lower-level signals comprises converting the first and second incoming network signals into signals having a common format; and

said step (b) of producing the higher-level signals comprises converting upward the common format signals.

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36. The two-way signal conversion method according to claim 29, wherein the conversions of the network signals include at least one of:

15 two-way conversions between high-order group signals belonging to different hierarchical series of signals;

two-way conversions between low-order group signals belonging to different hierarchical series of signals; and

20 two-way conversions between a high-order group signal and a low-order group signal which belong to different hierarchical series of signals.

37. The two-way signal conversion method according to claim 29, wherein the conversions of the network signals include at least one of:

two-way conversions between SDH signals and SONET

signals;

two-way conversions between such signals that belong to the same hierarchical series of signals, but have different levels in the hierarchy;

5 two-way conversions between PDH signals; and
two-way conversions between ATM signals.

38. The two-way signal conversion method according to claim 29, wherein said step (a) of producing
10 the lower-level signals comprises:

identifying AU pointer types of the first and second incoming network signals; and

converting the first and second incoming network signals, based on the identified AU pointer types.

15 39. The two-way signal conversion method according to claim 29, wherein said step (a) of producing the lower-level signals comprises:

identifying a value given in a byte in a frame
20 overhead of each first or second incoming network signal;
and

converting the first and second incoming network signals, based on the identified byte values.

25 40. The two-way signal conversion method according to claim 29, further comprising the step of using a network management console for operations and

maintenance of the conversions of the network signals.

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